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EVALUATION OF PACKAGING FOR THE CN-1325/ASN-108 AHRS DISPLACEME--ETC(U)
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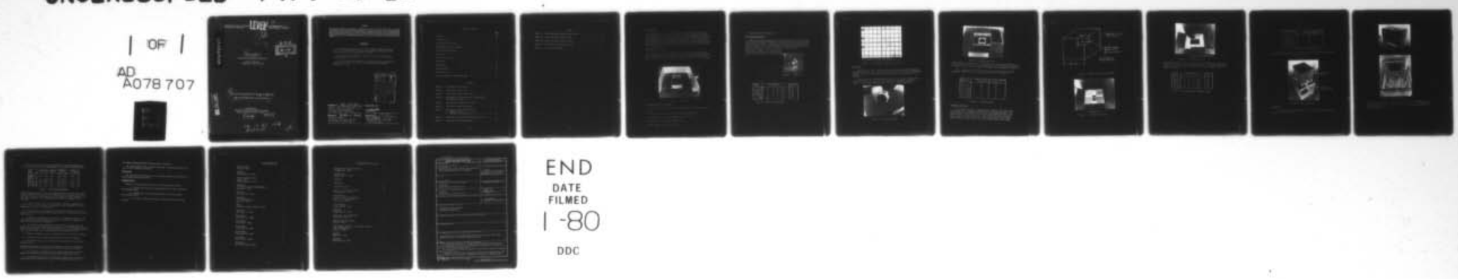

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EVALUATION OF PACKAGING FOR THE CN-1325/ASN-108 AHRS DISPLACEMENT GYRO (F-15 AIRCRAFT)

HQ AFALD/PTP
AIR FORCE PACKAGING EVALUATION AGENCY
Wright-Patterson AFB OH 45433

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NOTICE

ABSTRACT

The packaging evaluation of the CN-1325/ASN-108 AHRS Displacement Gyro (F-15) revealed that the pack is not adequate to provide the 15G shock protection level required for this item.

The field tests confirmed the laboratory results which produced a maximum impact force of 21 Gs.

A prototype pack with corner pad cushion inserts was evaluated and found to be suitable as an interim or a permanent replacement for packaging this item.

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INTRODUCTION

In May 1979, the F-15 Program Office (ASD/YFL) expressed concern about the mechanical failures of the CN-1375/ASN-108 AHRS Displacement Gyros (NSN 6615-00-303-6728). Since packaging and handling was suspected as a contributing factor, a cooperative effort by OC-ALC/DSPA and this Agency (AFALD/PTPT) was undertaken to investigate the packaging for this item. Both field tests and in-house performance evaluation revealed that an improved pack was needed to provide the required 15G shock protection level for this gyro.

DESCRIPTION OF TEST PACK

The test pack (TPO 00-303-6728) is a reusable single wall fiberboard container (30" X 26" X 26") with complete cushioning encapsulation. The 1.5 pcf polyurethane cushioning material is 9 inches thick and the gross weight of the pack is 42 pounds. The test pack is shown in Figure 1.

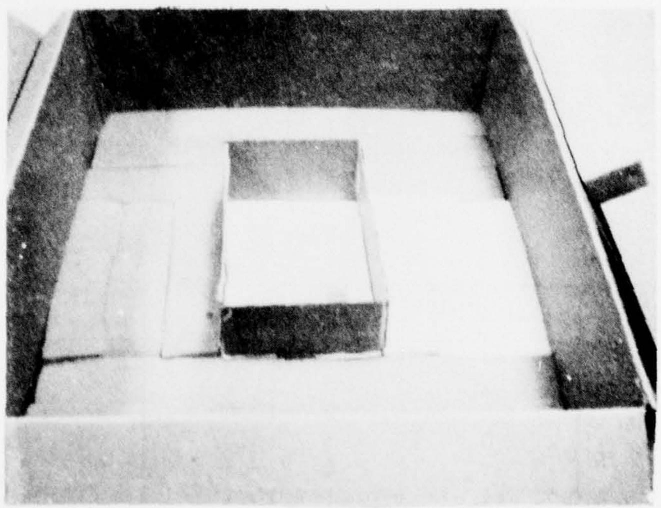


Figure 1. Test Pack

INSTRUMENTATION AND EQUIPMENT

The following instrumentation and equipment were employed in this study:

1. Oscilloscope, 4 channel storage, Tektronix Model 564-B
2. Accelerometer, tri-axial, Endevco, Model 2233E
3. Amplifier (3 ea.) Endevco, Model 2614C
4. Power Supply, Endevco, Model 2622C

5. Gaynes Drop Tester, Model 125

TEST PROCEDURE/RESULTS

The test pack was subjected to a free fall drop test in accordance with Federal Test Method Standard 101B, Method 5007, Procedure B, Level A, 30 inch drop height. A tri-axial accelerometer was secured near the center of gravity of a 12 ½ pound wooden test load (figure 2) and packaged as specified in the TPO. The results of the drop tests are listed in Table I. The oscilloscope trace of the acceleration - time history of the bottom face drop is shown in Figure 3.

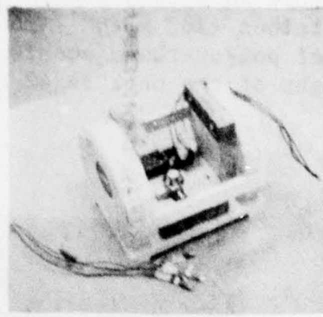
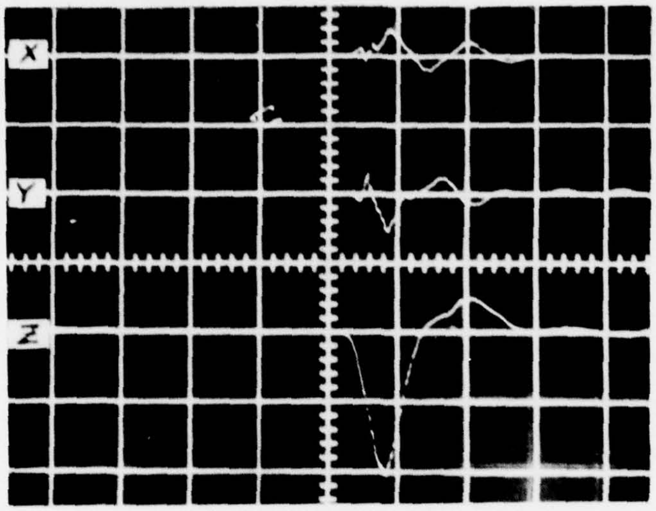


Figure 2. Test Load

IMPACT FACE	ACCELERATION - G X	Y	Z	R	Duration ms
3 (bottom)	5	5	20	21.2	50
1 (top)	4	6	18	19.4	55
2 (front)	0	13	3	13.3	60
4 (back)	1	17	4	17.5	60
5 (l. end)	14	1	1	14.1	55
6 (r. end)	13	3	4	13.9	55

Table I. Peak Acceleration Data



10 G/cm (vert.), 50 ms/cm (horiz.)

Figure 3. Acceleration - Time History (face 3)

FIELD TEST

Two field tests were conducted between Wright-Patterson AFB, Ohio and Tinker AFB, OK via Logair. The first trip was initiated prior to conducting in-house performance evaluation to avoid damaging the test pack prior to shipment.

A Transportation Environment Recorder (TER) was secured in the cavity of the wood test load (figure 4) and packaged for shipment as shown in Figure 5. The TER recorded the shock input data for the round trip

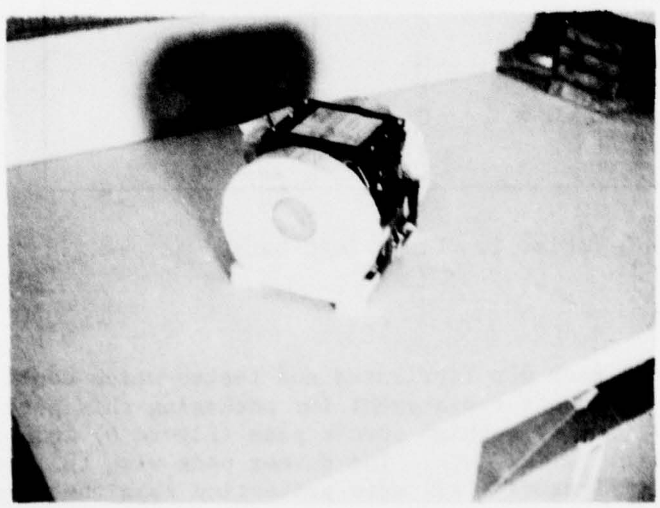


Figure 4. Test Load with TER

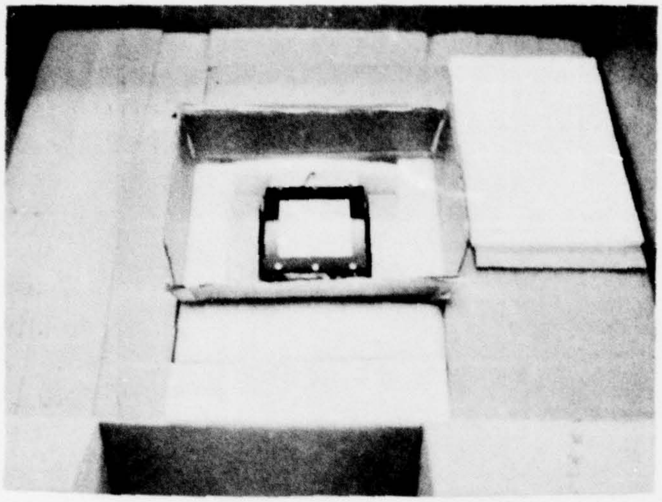


Figure 5. Complete Test Pack

between WPAFB and Tinker AFB. A resultant type recoıder was selected for this test series because it has the capability to electronically compute the resultant valve of the three mutually perpendicular components (X, Y & Z).

After completion of the in-house tests, the second field test was conducted. The results of both trips are presented in Table II.

SHOCK LEVEL RANGE - G	NUMBER OF RESULTANT VALUES RECORDED Trip No. 1	Trip No. 2
2.5 to 5.0	96	64
5.0 to 7.5	24	13
7.5 to 10.0	9	7
10.0 to 12.5	6	3
12.5 to 15.0	1	2
15.0 to 17.5	0	1
17.5 to 20.0	1	1
20.0 to 22.5	1	0

Table II. Field Test Data

PROTOTYPE TEST PACK

A prototype test pack was fabricated and tested which could serve as an interim or a permanent replacement for packaging this gyro. The polyurethane (2 pcf, ester) cushion corner pads (figure 6) were tested with and without shear relief cuts. The corner pads with the shear stress relief cuts will provide 13% more protection than the original pads. Normally stress relief cuts do not significantly affect pack

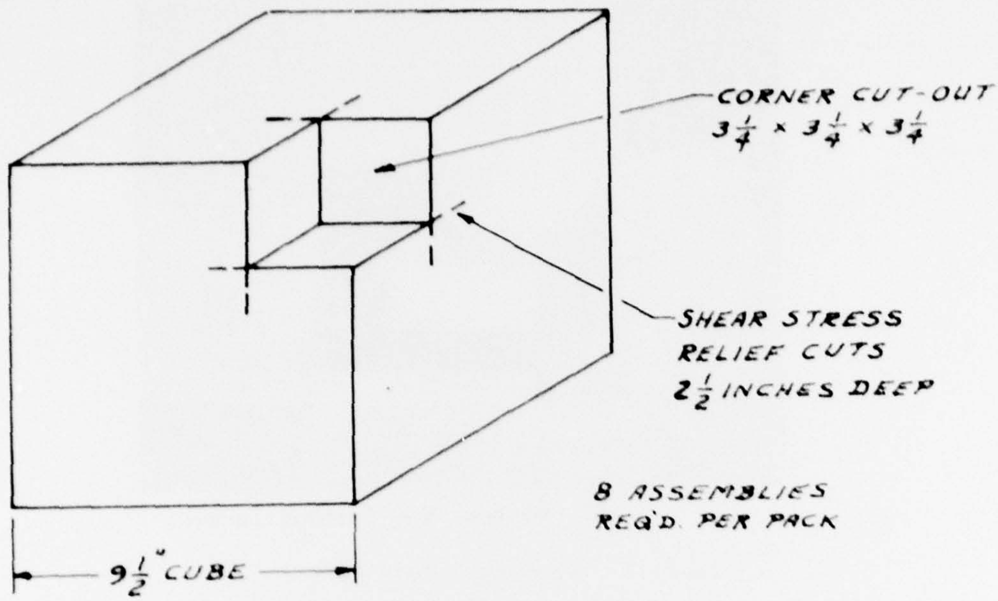
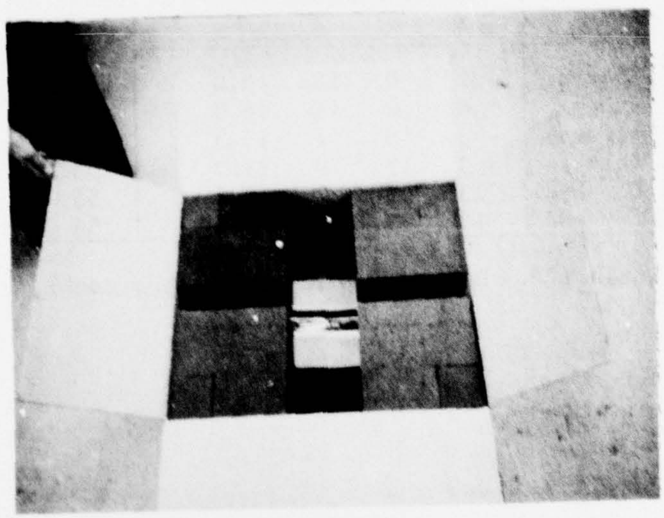


Figure 6. Sketch of Corner Pad Assembly



a. Complete Pack

Figure 7. Prototype Test Pack

b. Without Top Cushion Inserts

Figure 7. Prototype Test Pack

performance; however, because of the gyro's light weight (12 ½ lbs.) this becomes more critical. The drop test results of the prototype pack are listed in Table III and the field test results are listed in Table IV (identical route).

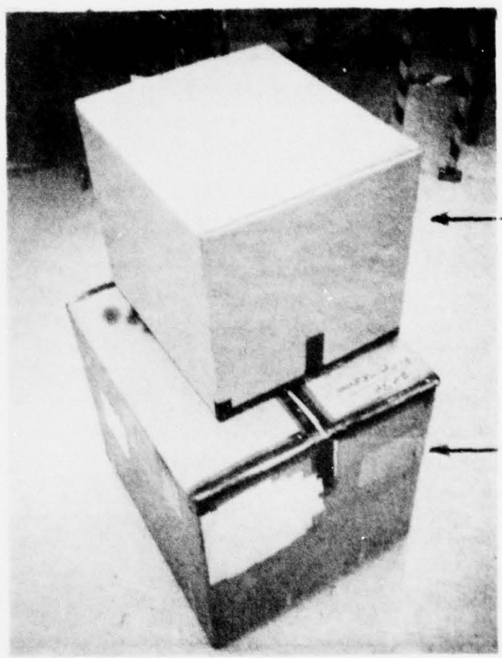
IMPACT SURFACE	ACCELERATION- G				DURATION
	X	Y	Z	R	ms
3 (bottom)	1	0	15	15.0	55
1 (top)	0	0	14	14.0	65
2 (front)	3	15	1	15.3	60
4 (back)	3	13	0	13.3	55
5 (l. end)	13	1	2	13.2	55
6 (r. end)	13	2	1	13.2	50

Table III. Drop Test Data (Prototype Pack)

SHOCK LEVEL RANGE Gs	NO. OF SHOCKS RECORDED (RESULTANT VALUES)
2.5 to 5.0	60
5.0 to 7.5	14
7.5 to 10.0	6
10.0 to 12.5	3
12.5 to 15.0	2
15.0 to 17.5	1

Table IV. Field Test Data (Prototype Pack)

A comparison of pack sizes of the corner pad design and the complete encapsulation design is revealed in Figure 8.



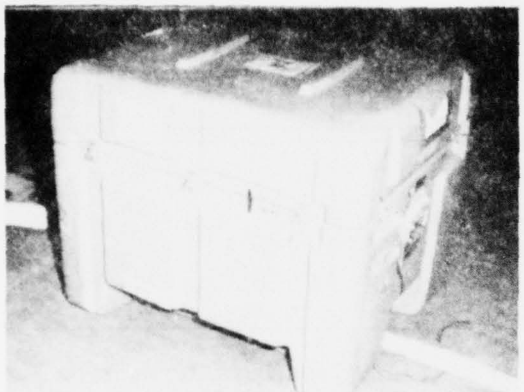
CORNER PAD DESIGN

COMPLETE ENCAPSULATION

Figure 8. Pack Comparison

DISCUSSION

A low fragility shipping container (P/N 15024-200), developed by the Navy, is shown in Figure 9.



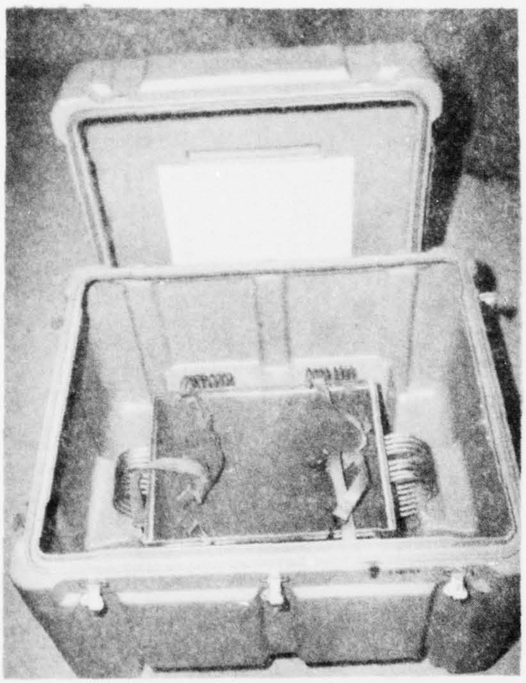


Figure 9. Navy's Container

This container, designed to transport fragile avionics equipment such as gyroscopes, was previously evaluated by this Agency. The isolation platform is suspended between flexible steel shock absorbing coils which protects the fragile items.

Table V lists three types of packs which will provide adequate protection for this item. The disadvantage of the packs incorporating the

TYPE PACK	DIMENSIONS (INCHES) L	W	H	VOLUME FT^3	GROSS WT. (Lbs)
CURRENT	30	26	26	11.7	42
AFPEA DESIGN	24	20½	20½	5.8	25
ATA-300	~28	~22	~24	10-15	~65
15024-200	35	30	29	17.6	86

TABLE V. TEST PACK INFORMATION

foam cushioning system is that consecutive drops on the same surface will generate shock levels above the 15 G fragility level; whereas, the flexible steel isolators in the Navy's pack will limit the level regardless of the number of drops. Other advantages of the Navy's container are as follows:

a. Previous field tests of this container produced a maximum shock level of 7 Gs. This, in part, is attributed to the container's size and weight which requires a two man lift.

b. The position of the handles, well above the center of gravity of the pack, will discourage personnel from carrying the container in an upside down position.

c. Extremes in temperature do not affect the isolation system. Foam type cushioning systems frequently experience a significant change due to high and low temperature environments.

d. If an item is discontinued from the Air Force inventory the container can be used for similar fragile items since the weight range is between 10 and 40 pounds. This will reduce disposal cost, redesign/modification cost and contractural cost of purchasing new or replacement packs.

e. Reduce the number of types of containers in the Air Force inventory.

f. Reduce man-hours required for preparing an item for shipment.

g. With minor repairs, this container has a potential of more than 100 round trips.

Although the advantages of this pack are numerous, careful consideration should be given to the following points when utilizing this container:

a. The item must be centered on the isolation platform to prevent an imbalance load which could generate higher than normal shock levels.

b. The weight and volume of this container requires that economics be considered for each application to insure that transportation costs do

not negate advantages gained through greater reusability.

The ATA-300 (100 trips) container would have a cushioning system identical to the fiberboard container.

CONCLUSIONS

The currently used TPO pack will not provide adequate shock protection during rough handling situations.

RECOMMENDATIONS

Replace the existing pack with one of the following test packs:

a. Reusable RSC double wall fiberboard with a corner pad design (polyurethane-ester).

b. Reusable 100 trip ATA-300 pack with a corner pad design (polyurethane-ester).

c. The Navy's 15024-200 reusable container with Aeroflex shock isolators.

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